

“Total Factor Productivity and Telecommunications: Policy Ingredients for Shared Growth”

**Remarks as Prepared for Delivery at
AEI’s Center on Internet, Communications and Technology Policy**

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I am thrilled to be speaking at the inaugural session of the American Enterprise Institute’s new Center on Internet, Communications and Technology Policy. I believe these are vital issues to understand in order to foster growth, create jobs, and increase the well-being of consumers. You are kicking off the Center by focusing on one of the most important and timely issues in this area: spectrum policy, an issue that the President has been personally interested in since he came into office, and one that I would love to discuss at length.

But, being the first speaker of the day, I am going to take the opportunity to talk more broadly about technology and economic growth. In particular, I want to focus on how sound public policies can catalyze private investment, innovation and growth—and some of the steps we should take to ensure that the benefits are shared more broadly.

The Importance of Total Factor Productivity and Shared Growth

The closest thing to a free lunch we have in economics is innovation that makes it possible to produce more output from a given amount of capital and labor. Economists call this Total Factor Productivity (TFP). In 2012 an American worker could produce nearly 5 times more per hour than his or her predecessor could in 1948. A basic growth accounting shows that 9 percent of this increase is due to improvements in the composition of labor, 37 percent is due to increases in the amount of capital they have at their disposal, and 54 percent is due to increases in total factor productivity (or what the Bureau of Labor Statistics data refers to as Multifactor Productivity). Total factor productivity reflects not just technology but also organizational innovations, improvements in the allocation of capital and labor, and returns to scale, for example, due to the opening of new markets.

Although total factor productivity has generally increased, these increases have been anything but steady. From 1948 to 1973 total factor productivity increased 2.2 percent annually. From 1973 to 1987 total factor productivity only grew 0.5 percent annually, famously leading Bob Solow to write “You can see the computer age everywhere but in the productivity statistics.” It has gotten somewhat better since Solow wrote those words in 1987, with total factor productivity growth doubling to an annual rate of 1.0 percent since then, but this is still less than half the rate in the post-World War II golden age. Moreover, in a double-whammy for middle-class families, the slowdown in productivity growth happened at just around the same time that inequality began its rapid rise.

Recently there has been an active debate between Robert Gordon who worries that we have run out of major ideas, are encountering increased headwinds and that growth will slow and

others, like Erik Brynjolffson and Paul Krugman, who take the opposite view. While this is an interesting debate, it is in many ways largely academic. Regardless of one's stance on it, the main implication is the same: we should be pursuing policies that increase our productivity.

This is important because, all else being equal, more productivity growth is always better for middle class families. While compensation growth for typical families was well below productivity growth in recent decades, it does not follow that *increasing* productivity growth will not *increase* compensation growth. The inequality in recent decades would be somewhat less of a problem if all incomes were 69 percent higher, which would have happened if total factor productivity had remained on the 1948-73 trend and those benefits were distributed proportionately. Moreover, I believe some of the benefits of innovation have not been captured in the typical GDP and income statistics. For example, the Internet and the associated system of networked technologies both serve markets and create markets of their own—markets like the app environment and wireless data. They have produced a huge consumer surplus—and in many ways have been a democratizing force. Just about any one of the roughly 140 million Americans with a smartphone has instant access to most of the same information as the very richest American.

However, we need to be mindful that everything is not always equal and that new technologies can create digital divides and other new avenues for increased inequality. Combatting that is not just important for the middle class and those struggling to get into the middle class, but ultimately, it is also good for productivity growth too, as expanding access and skills for technology to more people means that we have more talent to draw on in growing the economy. So we need to pay attention to measures that make sure that everyone shares in the benefits of technological progress.

With these lessons in mind, I want to talk about some of the steps we have taken to promote technological growth in the area of telecommunications and also some of the further steps we should take.

America's Leadership Role in Telecommunications and the Digital Ecosystem It Has Fostered

Improved telecommunications infrastructure, particularly fast and widely-accessible wired and wireless broadband networks, enables synergistic technological advances in business, healthcare, education, public safety, entertainment, and more. In education alone, it carries enormous potential to improve student learning and reduce achievement gaps. The combination of increased broadband speeds along with high-powered devices means that we have the potential to give everyone their own mobile supercomputer.

The telecommunications sector has been investing heavily and is a major success story for our economy. We documented many of the striking statistics in the recent White House report on "Four Years of Broadband Growth," including:

- Just two of the largest U.S. telecommunications companies account for a greater combined stateside investment than the top five oil and gas companies, and nearly four times more than the big three auto companies combined.
- In the last four years annual investment in U.S. wireless networks grew more than 40 percent from \$21 billion to \$30 billion. At the same time investment in European wireless networks remained flat and wireless investment in Asia (including China) rose only 4 percent.
- The United States leads the world in the availability of advanced 4G wireless broadband Internet services such as LTE; nearly half of the global subscriber base for 4G LTE is in the United States.
- The United States ranks among the top countries in the world in the amount of currently licensed spectrum available for mobile broadband.

This infrastructure is at the center of a vibrant ecosystem that includes smartphone design, mobile app development, and utilizing these technologies to effect broader changes in our economy and society—all of it centered here in the United States. The mobile app industry is forecast to raise over \$25 billion in revenue in 2013, rising to \$74 billion in 2017, with nearly 2 million applications available for download in the two largest mobile app stores.

While we have a lot to be optimistic about in this area, we also need to be mindful of ensuring that these benefits are broadly shared throughout our society given some of the other facts documented in the White House report, including:

- *Uneven adoption by education and income.* Home broadband adoption is twice as high for college graduates as high school dropouts; overall 28 percent of Americans do not use broadband at home, many of them in lower-income households.
- *Uneven adoption in rural areas.* Although nearly all urban residents have access to 6 Mbps downloads, only about 82 percent of residents in rural communities can access those speeds. And the disparity is larger at faster speeds.
- *Affordability challenges.* Affordability is one of the most cited reasons that households do not adopt broadband, and although speeds have increased, the prices consumers pay have remained steady or risen—without the huge quality-adjusted price reductions we have seen in technological hardware.

Policies to Promote Innovation and Investment

Innovation and investment have primarily been driven by the private sector. But Federal policy has played an important role from the beginning in catalyzing these private efforts. Next, I want to outline four important areas of policy, focusing especially on the policies the Administration has pursued and our proposals for further progress.

1. Government Investments in Research and Development

Although much valuable investment in innovation is private research and development, this investment will be below socially optimal levels when there are spillover benefits that cannot be captured by the innovating firms, creating a role for direct government investment. Perhaps the most famous government investment in the area we are discussing today is the Defense Advanced Research Projects Agency (DARPA) developing the Internet. But important defense-based public research contributions predate that, from the radio to most recently GPS, now central to a huge number of consumer apps.

Today, the Department of Defense continues to play an important role in helping to develop the ideas and technologies for spectrum sharing, including by soliciting innovative research proposals aimed at efficient and reliable sharing of spectrum between radar and communications systems. All told, we are making \$100 million in Federal investments in spectrum sharing and advanced communications through the National Science Foundation (NSF), DARPA and the Commerce Department.

2. Catalyzing Private Innovation

The government also plays an important role in catalyzing private innovation by creating a tax, legal, and regulatory framework that supports it. To that end, one important proposal is to extend, reform and make permanent the Research and Experimentation tax credit—including a roughly 20 percent increase in the value of the credit—to reflect the fact that research creates external benefits that are not fully captured by the firm undertaking the research.

Innovation is perhaps even more dependent on the way that intellectual property is treated. Strong intellectual property protections are critical to give firms incentives to innovate, allowing them to capture the benefits of their ideas. But the relationship between patent protections and innovation is not monotonic—if protections are misapplied, that will reduce competition, directly hurting consumers and ultimately chilling innovation.

Getting this balance right in the area of smartphones is particularly important not just because these complex devices embody over 100,000 patents each, but more fundamentally because the very nature of communications and networks is that it entails exchanges between devices and each other and networks—which in turn depends on developing standards for interoperability. Currently if a firm's proprietary technology becomes an industry standard (Standard Essential Patent), the owner must license the technology on F/RAND terms. But this practice can lead to a "holdup" problem if firms attempt to assert their rights after the standard has been adopted and other firms have made investments based on them, making their proprietary technology far more valuable ex-post than it was ex-ante before the standard was adopted. The recent decision by United States Trade Representative Mike Froman to reverse the International Trade Commission's decision in the Apple/Samsung matter reinforced the principle that, when it comes to Standard Essential patents, exclusion orders should be granted under only a narrow set of circumstances and should not strengthen the hand of holdup. Instead, these types of cases should be resolved largely in the Federal court system which avails itself of a broader

set of remedies. Ultimately, however, the goal would be to have the ITC incorporate these considerations into its approach, something it could do by itself or through the legislative proposals the President outlined in June as part of his broader “Innovation not Litigation” agenda.

Finally, it is also worth noting that commonsense immigration reform would also meaningfully increase investment and innovation. Studies co-authored by Jenny Hunt, the current Chief Economist of the Department of Labor, have found that immigrants patent at two to three times the rate of U.S.-born citizens—and that they also create positive spillovers for innovation by their U.S.-born colleagues. CBO projects that the Senate-passed immigration bill would raise total factor productivity by roughly 1.0 percent by 2033.

3. Building and Catalyzing Technological Infrastructure

The federal government funded the country’s first investment in telecommunications infrastructure, a telegraph line from Washington D.C. to Baltimore built in the 1840s. But since then, appropriately, the vast majority of technological infrastructure investment has been private. But that is not to say that public policy is not important.

Here too tax policy matters. In 2010 the President proposed and signed into law the largest temporary investment incentive in history—100 percent expensing—that, together with the bonus depreciation that preceded and followed it, played a critical role in increasing and accelerating investment, including the substantial increases in both wired and wireless investment in the telecommunications sector that I discussed earlier. For example, two major companies in a joint statement said that “despite the downturn in the economy, the cable communications sector has been able to continue steady investment and to retain jobs as a result of policies like 100 percent expensing.”

These extraordinary incentives were designed as temporary measures to help recover from the worst financial crisis since the Great Depression. Ultimately, we would like to see broader business tax reform that increases the incentive to invest and to allocate that investment to the most efficient purposes as part of a Grand Bargain for Jobs that also includes increased investments in infrastructure and other upfront job creation efforts.

We also must recognize that investments in infrastructure depend critically on a stable, predictable and light touch regulatory regime. Companies make major financial commitments upfront and only realize the returns to these commitments over time. To make the investments, they require stability and predictability. That is not the same as no regulation—there are many legitimate needs and goals for regulation—but it is the motivation for the approach this Administration and the Federal Communications Commission (FCC) have taken in a wide range of areas like Open Internet, cybersecurity, intellectual property and privacy—specifically, a multi-stakeholder approach that depends on a light touch and aims at specifying end results rather than prescribing the means to achieve them.

Catalyzing investment in mobile broadband is especially important given the collision of our use of technology with the laws of physics. We are increasing our use of wireless broadband at a fast and accelerating rate. But the quantity of spectrum is limited. Our response to addressing this spectrum challenge is based on the same “all of the above” approach the President brings to energy policy. That includes:

- *Reallocating licensed private spectrum to its most valuable use.* To this end, the incentive auctions originally championed by FCC Chairman Julius Genachowski and the Administration have provided us with a new tool that will be win-win-win: providing revenue for broadcasters that voluntarily agree to relinquish their spectrum, providing valuable spectrum for mobile wireless providers that purchase it at auction, and providing significant revenue for taxpayers. The magnitude of potential gains to social surplus are enormous when broadcasters with only thousands of viewers and low millions of dollars in annual revenue will have the choice of selling their spectrum for hundreds of millions of dollars to companies that will use it to improve services for millions of customers.
- *Reallocating public spectrum to its most valuable use.* The Federal government is a substantial user of spectrum dating back to when it was *de facto* a limitless resource. But federal use of spectrum is not costless—and as an economic matter, if spectrum would produce larger social surplus in private hands than in public hands then it should be reallocated. In some cases, like mission-critical defense and public safety functions, spectrum clearly needs to remain federal. But at the President’s personal insistence we have been taking a hard look at the allocation of spectrum under the leadership of the National Telecommunications and Information Administration’s (NTIA) Larry Strickling. A key early change was the NOAA band, and currently the Secretary of Commerce, working through NTIA, has been facilitating discussions between agencies and nonfederal entities that have produced an unprecedented level of information-sharing and collaboration to identify opportunities for agencies to relinquish or share spectrum in additional bands. This is important for spectrum bands that are particularly valuable for commercial applications in a way that they are not for government applications, for example if they are complementary to other commercial spectrum bands. It is also worth pointing out that the ultimate economic test depends not on government revenue net of relocation costs, but on the social surplus that is created by the transaction—which can be many multiples of the revenue itself.
- *Adding to unlicensed spectrum.* The “all of the above” approach also includes unlicensed spectrum which, together with licensed spectrum, plays an important role in the innovation ecosystem—enabling devices from garage openers to Wi-Fi to smart homes. The value of this spectrum has been estimated at \$16 billion to \$37 billion per year. A great deal of mobile usage is so-called “nomadic” usage (e.g., at home, office, or other fixed location), amenable to carriage by a wired connection using a nearby unlicensed Wi-Fi router, as opposed to “on-the-go/in transit” mobile usage that depends on a carrier’s licensed network. We have made progress here as well, for example most recently in February the FCC proposed to make up to 195 megahertz of additional spectrum in the 5 GHz band (a 35 percent increase) available to unlicensed wireless devices. The FCC also proposed to create a more flexible regulatory environment and to

streamline existing rules and equipment authorization procedures for devices throughout this band.

- *Promoting spectrum sharing.* The traditional approaches to clearing spectrum for either exclusive licensed use or shared unlicensed use remain important, but given the dramatic spectrum challenge and the fact that much of the lowest hanging fruit for reallocation has already been picked, we also must focus on newer and more innovative ideas to share spectrum. The President's Council on Science and Technology (PCAST) released an important report by Mark Gorenberg and his team, and today we are acting on it. That report estimated that "in the best circumstances, the amount of effective capacity that can be obtained from a given band of spectrum can be increased thousands of times over current usage through dynamic sharing techniques that make optimal use of frequency, geography, time and certain other physical properties of the specific new radio systems." The 2010 Presidential Memorandum that set our Administration's spectrum goal originally contemplated sharing as one of the means for achieving the goal, and we recently took further steps by issuing a new Presidential Memorandum dedicated to this purpose, including establishing a Spectrum Policy Team in the Executive Office of the President charged with the mandate to "monitor and support advances in spectrum sharing policies and technologies." In addition, the memorandum is designed to facilitate research, development, testing, and evaluation of technologies to enhance spectrum sharing and other spectrum-related efficiencies.
- *Increasing investments in wired broadband, the density of wireless cells and innovations to use spectrum more effectively.* Finally, no matter how much spectrum we free or share, it will never be close to enough to keep up with the rapidly exploding demand. The ambitious goal the President set in his 2010 Memorandum to free up 500 MHz of spectrum would nearly double the amount of wireless spectrum available for mobile broadband over the course of a decade. But that would only be enough to satisfy about one year's worth of spectrum usage growth. As a result, it is important to do everything from increasing investments in wired broadband networks that can reduce some of the burden (including by making the last wireless connection through Wi-Fi rather than cellular), increasing the density of wireless cells, and other technological innovations to use spectrum more efficiently. We are trying to help with these efforts in a variety of ways, including the FCC speeding up the approval process and the June 2012 Executive Order issued by the President specifying a number of steps that will ease and facilitate carriers' access to Federal land and buildings for purposes of deploying broadband infrastructure, including cell towers.

4. Broad Participation

Finally, as I discussed earlier, our policies have the goal of ensuring broad participation in the benefits of these technologies. This is not just because we care about the end itself—a stronger middle class—but also because broad participation is a means to bringing more talent to bear and thus higher economic growth and a virtuous circle with higher living standards.

One element of broad participation is ensuring that technology and its products be affordable, or at a minimum that the prices or choices are not inflated by lack of competition. To that end, vigorous antitrust enforcement is important. That is something you have seen our law enforcement agencies undertake, and that is important as a policy consideration going forward as well.

In addition, the government can make critical investments in expanding broadband to underserved communities. We have already done that with the Broadband Technology Opportunities Program (BTOP) and Broadband Initiatives Program (BIP) programs from the Recovery Act. As of the end of May 2013, these programs have invested over \$4.2 billion in more than 325 projects. They have built and improved over 90,000 miles of broadband infrastructure and made high-speed connections available to about 14,000 community institutions. The FCC has also played an important role in reallocating the funds we already collect toward expanding broadband in unserved and underserved areas through Universal Service Reform and the establishment of a \$4.5 billion annual Connect America Fund.

One of the initiatives we are most excited about to promote broad participation going forward is ConnectED. The motivation for this program is the simple observation that the average school has a broadband connection that is slower than that of the average home, despite serving hundreds of students. As a result, the bandwidth may be entirely used by one classroom watching YouTube—making it impossible for students in the neighboring classroom to use other cloud-based learning technologies while students in a third classroom are taking the computer-based tests for the Common Core.

The President has called on the FCC to modernize and leverage existing programs, as well as the expertise of the NTIA, to deliver this connectivity with the goal of connecting 99 percent of America's students to the digital age through next-generation broadband and high-speed wireless in their schools and libraries.

The initiative, however, is not just about infrastructure—equally critical is ensuring that we have the devices, the software innovations, and the teacher training necessary to make the best possible use of this infrastructure, all measures which are a focus of the White House and the Department of Education. Ultimately the vision is a world-class education for every student that does not depend on their family's income or the zip code they were born in.

Conclusion

Broadband technology has already generated major benefits and will continue to do so in the future. It sits at the nexus of a wide range of policy areas, including discretionary funding for research and development, business tax reform, regulatory policy, the "Innovation not Litigation" patent reform agenda, commonsense immigration reform and of course the "all of the above" approach to broadband and spectrum use. The Administration remains committed to working through all of these channels to create a policy environment that will encourage and enable growth for the benefit of all Americans.